



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

HISTOGENESIS IN INSECT DEVELOPMENT, AND CELL SPECIFICITY.

VERNON L. KELLOGG.

In the development (ontogeny) of insects with complete metamorphosis the imaginal antennæ, mouth-parts, legs and wings are produced from small buds, or histoblasts, in the larval derm. These histoblasts or imaginal buds arise by the shallow or deep invagination (one for each histoblast) of small regions of the larval cellular skin layer including originally, in each case, only comparatively few derm cells. The position of these invaginations, and therefore the participation of derm cells in the future leg or wing development, seems to be determined wholly with reference to the future imaginal organ, and not at all with reference to any difference in degree of differentiation among the cells of the larval derm. The wing-buds arise from the latero-dorsal regions of the meso- and meta-thoracic segments, the leg-buds from the latero-ventral regions of each of the three thoracic segments.

The larval derm is certainly not to be looked on as composed of wholly undifferentiated embryonic cells. These derm cells make up a definite organ, or part, of the larval body, with definitive position and particular functions. All these cells, and no others in the body, secrete¹ chitin; some of them secrete noxious fluids, ill-smelling, acrid, poisonous. Many of them, perhaps all, secrete moulting fluid at the times of the regular larval moults; many are specially sensitive, many bear sense-hairs or papillæ.

The invagination and beginning development of small parts of this derm, in a wingless and legless larva of a fly or honeybee or of some other specialized insect, may occur in a very early larval stage (in some cases, indeed, indications of the future histoblasts are apparent in just-hatched larvæ), but in most cases the invagination does not appear until a certain part of the free larval life has been lived. That is, the larval derm has for awhile

¹ The chitin secreting capacity of the anterior and posterior thirds of the insect alimentary canal is due to their deeply invaginated derm.

subversed only, and has subversed fully, the functions of skin, and its cells have certainly attained whatever differentiation they need for the performance of these functions. It is far and away a long cry back to the embryonic, undifferentiated, the non-specific condition. But apparently any part or region of this derm which may, by its position, be the region or part needed to develop an antenna, a wing, a leg, male clasper, female ovipositor, or a sting, can respond to the need, and by invagination (for protection's sake), rapid growth and proliferation of cells, quick differentiation and arrangement, and final evagination (at the time of the last larval moulting, *i. e.*, pupation) produce the needed organ. This organ may be tubular and segmented, and the segments may be similar (antennæ); or dissimilar (leg); or it may be a great flattened sac, supported by tubular skeletal ribs and covered by a million and more tiny other striated, pigment-bearing, flattened sacs (the butterfly's wing with its scales); or it may be the exquisite mechanism of the bee's sting.

This histogenesis of the imaginal parts of the fly, the bee, and the moth is, to my mind, an extremely suggestive phenomenon when considered in the light of its relation to the theories of cell-specificity or cell-non-specificity. Quite as positively as the more familiar cases of restorative regeneration (legs, eye-lenses, tails and what not of various vertebrates), does this radical histogenesis, common to the ontogeny of all insects with complete metamorphosis, make it impossible to limit the germ-plasm to the germ-cells. It stands strongly opposed to any theory of absolute cell-differentiation or cell-specificity.

STANFORD UNIVERSITY, CALIF.